Impact of Uncertainty on the Prediction of Airspace Complexity of Congested Sectors

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The ability of traffic controllers to separate aircraft determines the capacity of the region of airspace under their control, referred to as a sector. Complexity metrics, specifically dynamic density, is used as an estimate for controller workload. The prediction of dynamic density is required for the development of efficient strategic air traffic flow plans. This paper explores the influence of trajectory errors and unexpected aircraft on the prediction of dynamic density. A worst-case analysis is used to describe the conditions under which forecast uncertainty may lead to excessive complexity. Although the approach has general applicability, it is described using one complexity metric. Depending on the sector and the complexity function, when a sector is highly congested, the method identifies aircraft entering the sector at certain locations, boundaries, and altitudes, whose errors in prediction impact the increase in workload significantly. Results based on the analysis of 72 days of traffic data in the Atlanta Center show that the impact of prediction errors on complexity depends on the direction and altitude of the traffic. The normalized increase in complexity due to prediction errors in Sector ZTL50 is two times or higher for traffic coming from ZTL42 as compared with traffic coming from ZTL32. The analysis is repeated for Atlanta Sector ZTL06 and Washington Center Sector ZDC37 to show the applicability of the method to other sectors. For certain types of incoming traffic, if these errors cannot be reduced, it may be necessary to limit the traffic approaching the sector from these boundaries.

Design Options for Advanced Arrival Management in the SESAR Context

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At the heart of Advanced Arrival Management (AAMAN) lies the ability to plan and control aircraft along trajectories that incorporate all relevant constraints into an integral solution (clearance) and that can be reliably executed by an aircraft. This paper discusses the AAMAN option of speed schedule / route modification (Speed And Route Advisor - SARA), as well as SARA’s relation to a complementary AAMAN option - Required Time of Arrival (RTA). Results from an operational trial of the speed schedule method at Schiphol airport showed a significant reduction in the variability of track miles flown in the Terminal Area (TMA). This reduction in track mile variability will enable introduction of fixed Precision Area Navigation routes (P-RNAV) in the Schiphol TMA. P-RNAV routes in the TMA are required for noise reduction, with the positive side benefit of providing flight efficiency benefits to airlines through increased predictability and reduced fuel burn. Usage of the RTA and speed schedule methods can be complementary, and is dependent on operational factors, such as traffic conditions, airspace layout, etc.
Evaluating the Impacts of In-Flight Icing Hazards

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This study analyzes in-flight icing constraints and air traffic data in order to identify how those constraints translate into Air Traffic Management (ATM) impacts in the National Airspace System (NAS). The analysis includes major safety and efficiency issues NAS users consider when making decisions due to in-flight icing. Data suggest that in-flight icing is a terminal-area constraint with greatest impact when the icing constraint is on or near ground level; above-ground icing constraints can often be mitigated by directing traffic flows to pass under or around the icing constraint to and from terminal airports. Terminal-area icing does not impact en route traffic flow, but it can impact planning when a major airport is restricted by terminal-area icing. Statistical analysis developed in this study indicates that the most significant ATM impacts include delays, cancellations, diversions, airborne circular holding, and decreased airport arrival and departure rates.